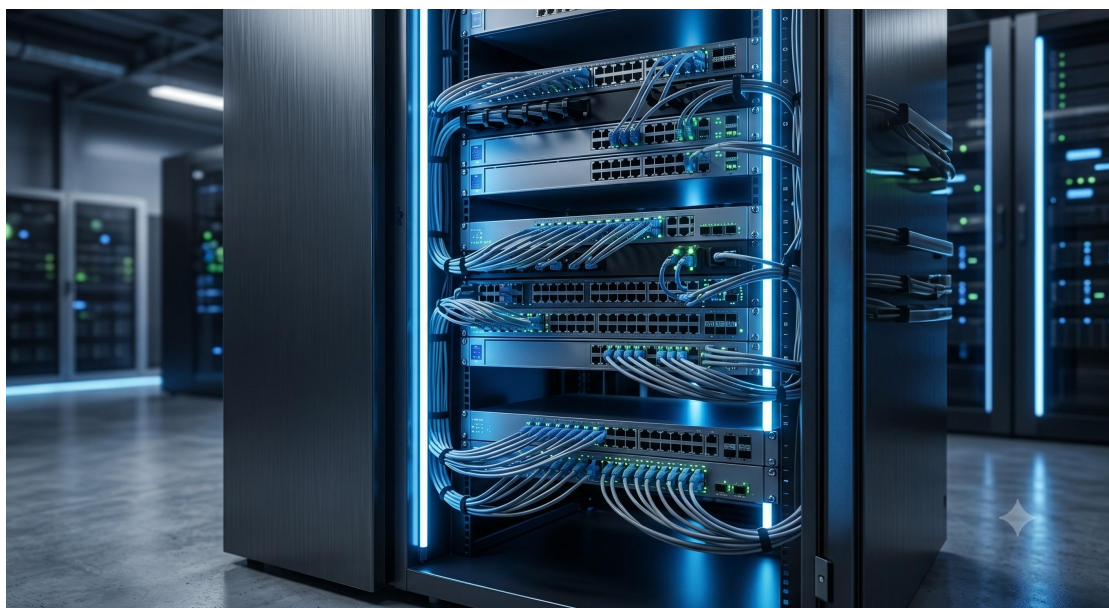


Spanning Tree Protocol RSTP MSTP - Official Technical Overview & Hardware Datasheet

PRODUCT OVERVIEW & ARCHITECTURAL POSITIONING

As carrier-grade Ethernet networks evolve toward high-density subscriber aggregation and multi-tenant virtualization, the loop-free logical topology remains the single most critical control plane function. The Spanning Tree Protocol (STP), Rapid Spanning Tree Protocol (RSTP), and Multiple Spanning Tree Protocol (MSTP) implementation within our switching infrastructure delivers deterministic failover, VLAN-based load balancing, and legacy interoperability. This document specifies the hardware-accelerated STP/RSTP/MSTP engine integrated across our Edge Routing and Access Switching portfolio.



CONTROL PLANE HARDWARE TOPOLOGY

The STP/RSTP/MSTP protocol suite is offloaded to a dedicated Network Processor Unit (NPU) with a parallel state machine engine, decoupling spanning tree computation from the host CPU. This architecture guarantees sub-second reconvergence under link or bridge failures. Key topology features include:

- Hardware-based Bridge Protocol Data Unit (BPDU) processing at line rate
- Per-VLAN spanning tree (PVST+) simulation for hybrid Cisco legacy environments
- Up to 64 MSTI instances per chassis with independent root bridge election
- PortFast, BPDUguard, and Loopguard in hardware access control list (ACL) ternary content-addressable memory (TCAM)

HIGH-AVAILABILITY REDUNDANCY MECHANISMS

RSTP accelerates transition from blocking to forwarding via explicit handshake (proposal/agreement), reducing convergence to sub-second (typically < 1 second for edge links). MSTP extends this by grouping multiple VLANs into a single spanning tree instance (MSTI), reducing control plane overhead in large Layer 2 domains. For carrier-grade environments, our implementation supports:

- 1+1 supervisor failover with hot STP state synchronization
- Link-state tracking to trigger root port reselection on physical link degradation
- Topology change notification (TCN) filtering to prevent broadcast storms during reconfiguration
- Interoperability with STP (802.1D), RSTP (802.1w), and MSTP (802.1s) on a per-port basis

Parameter	Specification
Form Factor	1RU / 2RU modular chassis
Switching Capacity	480 Gbps (non-blocking)
Power Supply	1+1 redundant hot-swappable AC/DC (dual feed)
Control Plane Redundancy	Active/Standby supervisor with stateful STP sync
Operating Temperature	-5 °C to +50 °C (standard), -40 °C to +70°C (ruggedized)
Mean Time Between Failures (MTBF)	> 250,000 hours (Telcordia SR-332)

PERFORMANCE & CAPABILITY METRICS

Forwarding Engine: Non-blocking shared-memory switch fabric

BPDU Processing Rate: 2,000 BPDUs per second sustained (per NPU)

Convergence Time (RSTP): < 1 second (edge to edge), < 6 seconds (core reconvergence)

Maximum MSTI Instances: 64 (hardware-supported)

Maximum VLANs per MSTI: 4,096

PortFast/BPDUguard Enforcement: Hardware TCAM (nanosecond decision)

Loopguard Inactivity Timer: Programmable, 1–300 seconds

Bridge Priority Granularity: 4096-step increments (standard 802.1D)

Hello Time Range: 1 – 10 seconds (default 2 seconds)

Max Age Range: 6 – 40 seconds

Forward Delay Range: 4 – 30 seconds

PROTOCOL INTEROPERABILITY & LEGACY ECOSYSTEM INTEGRATION

In brownfield deployments spanning multiple vendors, our platform automatically negotiates STP version on a per-port basis. Upon detecting legacy STP BPDU format (802.1D), the port demotes from RSTP to STP mode without manual intervention. For networks requiring per-VLAN load balancing without full MSTP configuration, our hardware supports PVST+ simulation, tunneling Cisco-proprietary BPDUs across the MSTP region. This ensures compatibility with existing access switches while maintaining deterministic

failover.

COMPLIANCE & REGULATORY DIRECTIVES

The spanning tree implementation adheres to the following standards:

- IEEE 802.1D-2004 (STP, RSTP)
- IEEE 802.1Q-2018 (MSTP, MSTI, Common and Internal Spanning Tree — CIST)
- IEEE 802.1w (Rapid Reconfiguration)
- IEEE 802.1s (Multiple Spanning Trees)
- MEF 9 & MEF 14 (Ethernet Services Phase 1 & 2)
- RoHS 2011/65/EU (Restriction of Hazardous Substances)
- ETSI EN 300 386 (Telecommunications network equipment electromagnetic compatibility — EMC)



ORDERING & SKU REFERENCE GUIDE

Base systems ship with a concurrent STP/RSTP/MSTP software license (no separate activation required). For high-availability configurations requiring hitless STP stateful failover, specify the redundant supervisor SKU. Field-upgradable line cards inherit the parent chassis spanning tree configuration automatically.

Note: All protocol timers (hello, max age, forward delay) are adjustable via CLI, SNMP, or NETCONF/YANG. Topology change notifications are exportable via syslog or gRPC telemetry for external orchestration.